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Does Closeness within LGBTQ Students' Support Networks Enhance Science and Engineering Identity?

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Abstract: *This study investigates the relationship between closeness within LGBTQ students' support networks and their science and engineering identity. Utilizing an egocentric social network analysis, data were collected from 507 students across four universities, focusing on LGBTQ students in STEM fields. The analysis revealed that personal support network closeness significantly predicts higher interest, competence, and recognition as a science person, but lower recognition as an engineering person. These findings suggest that personal support networks play a crucial role in bolstering science identity among LGBTQ students, highlighting the need for targeted support mechanisms within educational institutions to enhance diversity and inclusion in STEM.*

Key Words: LGBTQ students, STEM education, Science identity, Social support networks, Diversity

Lesbian, gay, bisexual, transgender, and queer (LGBTQ) students leave STEM majors at higher rates than their heterosexual or cisgender peers (Hughes, 2018; Maloy et al., 2022). One contributing factor to this problem is the LGBTQ climate within STEM (Fitzgerald-Russell & Grunert Kowalske, 2022; Miller et al., 2020), encountering microaggressions among other more insidious heteronormative and cisnormative biases (Pradell et al., 2024). To navigate this climate, LGBTQ students may employ identity management strategies such as "passing" as heterosexual or "covering," downplaying their queer or trans identities, strategies which require additional emotional and academic effort (Cech & Waidzunas, 2011; Hughes, 2017). Many transgender, nonbinary, and gender nonconforming (TGNC) students report an even more hostile climate in STEM (Haverkamp, 2019), given the higher political salience around transgender communities and the visibility of gender identity expression (Haverkamp et al., 2019; Kersey & Voigt, 2021). TGNC students report relying on queer and trans social support networks as critical to their navigation into, through, and sometimes out of STEM. Identity management seems to be a common experience for LGBTQ students in STEM fields, but this process focuses solely on these students' sexual and gender identities. Less understood is how LGBTQ students' navigation of STEM environments may influence their science or engineering identities.

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Policymakers and industry leaders have determined that broadening the participation of people from groups historically excluded from STEM will contribute to the vitality of these fields as there is a continual need for innovative solutions that require STEM knowledge and skills to solve complex global problems (Barnes et al., 2013; Zoghi et al., 2015). As such, educational research has focused on increasing diversity in STEM, especially at the postsecondary level (Palid et al., 2023), including an increased focus on LGBTQ students within the past decade or so. One area that has received considerable focus is science and engineering identity (e.g., Chen et al., 2020; Lakin et al., 2020), which is reflective of one's intrinsic motivation to pursue science or engineering as a field of study. Very little research has examined how LGBTQ students experience science or engineering identity (e.g., Hughes & Teye, 2024), and none has examined the role that support within social networks may play (Kersey & Voigt, 2021; Schmidt et al., 2010). Understanding how social support may influence science and engineering identity among LGBTQ students is then of particular interest, especially given the role of social support in shaping other academic and social outcomes.

THEORETICAL FRAMEWORK

For this study, we define science or engineering identity as a subject-related role identity regarding students' beliefs about their position within their chosen field (Carlone & Johnson, 2007; Godwin, 2016). Specifically, we employ Godwin's model which parses students' beliefs about engineering into three domains: recognition as an engineer, interest in engineering, and competence or performance in engineering-related tasks. These three dimensions have been shown to significantly affect engineering students' persistence in their majors and careers (Godwin et al., 2016; Hughes et al., 2019). Recognition involves external validation within academic circles, such as acknowledgment by professors and peers. Interest reflects students' motivation for engineering activities and career pursuits, vital for their initial major selection. Performance/competence entails students' confidence in their ability to excel academically and perform field-related tasks successfully. Thus, students' relationships with important others within science or engineering appear relevant to all three dimensions.

Social Support Theory then argues that the emotional, informational, and instrumental support within these interpersonal relationships can lead to high integration, or embeddedness in social networks, which is associated with improved wellbeing (Cohen & Wills, 1985), and can serve as a protective element, enhancing the psychosocial well-being and academic success of LGBTQ students. Meyer's (2003) research highlights the significant role of social support in mitigating minority stress and fostering resilience within LGBTQ communities, especially support from peers, family, and educational institutions. Moreover, Logie et al. (2016) and Wolowic et al. (2018) emphasize its multi-level advantages, encompassing self-acceptance, reduced isolation, and increased access to resources. Gutzwa et al. (2024) found that support from social networks, including peers, faculty allies, and identity-based affinity groups, helped lesbian and women physics graduate students develop and leverage their science identities specifically, providing essential navigational capital to overcome systemic barriers and thrive in their academic and professional journeys.

Both social support and compatibility of identity with field of study play crucial roles in developing science or engineering identity, particularly for underrepresented students (Cohen & Wills, 1985). For example, perceived identity compatibility and social support during college transitions predict greater sense of belonging and motivation in STEM (London et al., 2011), while social networks and STEM organizations can impact STEM identity development (Campbell-

Montalvo et al., 2023; Chestnutt, 2019). However, adverse academic encounters can lead to fluctuations in compatibility between gender and STEM participation for women (Ahlqvist et al., 2013), which may also diminish LGBTQ students' engagement and academic achievement within STEM disciplines. Humble (2021) advocates for further research that accounts for the diverse experiences and sources of social support within LGBTQ populations.

Considering one's social context, particularly for LGBTQ students, to be an important source of validation, inspiration, and continued motivation, the purpose of our study is to investigate the relationship between LGBTQ STEM students' social support, which we operationalize as closeness within personal and academic support networks, and their science and engineering identities. Specifically, the study aims to understand how the availability and quality of social support revealed through closeness within these networks influence LGBTQ students' interest, competency/performance, and recognition within STEM fields.

METHODS

To achieve the purpose of this study, we performed an egocentric social network analysis. Social network analysis is a method that aims to study how an individual's social context affects their experiences and outcomes (McCarty et al., 2019), and an egocentric approach focuses on the networks surrounding individual actors, as opposed to approaches that study whole networks. Students at four universities located in four different regions of the United States completed a two-part survey that collected data on a small subset of their social networks as well as their college experiences. The overall focus of the project is on LGBTQ students in STEM fields, so LGBTQ students and students in STEM majors are overrepresented in this dataset. The analytical sample for this study included 507 students, of whom 65.5% were STEM majors, 56% are LGBQ (lesbian, gay, bisexual, and queer), and 16.2% TGNC (transgender, gender nonconforming, and nonbinary).

We adapted Godwin's (2016) measure for engineering identity to broaden its applicability for students across a variety of fields as our dependent variable. Our adapted measure includes four separate scales: interest in one's chosen field, recognition by others as a science person, recognition as an engineering person, and competence in and performance of field-related concepts. We used exploratory factor analysis to test how well our data performed; all reliability coefficients were higher than .70 and factor loadings higher than .80. Scores for interest, performance/competence, and recognition each as a science person and an engineering person were calculated using factor loadings to produce weighted sums of the items composing each.

The primary independent variable is tie-closeness; students were prompted to identify up to 3 people across two domains of support, academic and personal, on whom they rely most. Students responded to a question regarding how close they are to each person, and average closeness was calculated within each of these two domains resulting in two scores, one for average closeness among personal support network members and another for academic support network members. We also included three demographic control variables based on the dimensions of students' experiences of central interest to the project: whether they identify as LGBQ (lesbian, gay, bisexual, or queer), whether they identify as TGNC (transgender, gender nonconforming, or nonbinary), and whether they are a STEM major. Table 1 provides descriptive statistics for our dependent and independent continuous variables.

We ran two sets of analyses to understand the relationship between average network closeness and identity. First, we tested whether network closeness differed by being a STEM major, LGBQ, or TGNC through a series of t-tests. Second, we ran a multivariate ordinary least-

Table 1. *Descriptive statistics for continuous variables.*

Variable	M	SD	Min	Max
Dependent Variables				
Identity: Interest	11.598	2.054	2.593	12.963
Identity: Recognition as a Science Person	9.912	3.147	2.656	13.278
Identity: Recognition as an Engineering Person	6.424	3.724	2.756	13.780
Identity: Competence/Performance	15.967	2.514	3.745	18.725
Independent Variables				
Average Closeness in Personal Network	3.701	0.390	2	4
Average Closeness in Academic Network	2.620	0.839	1	4

squares regression model to test if the two measures of network closeness predicted the four dependent variables, controlling for our three demographic control variables.

RESULTS

We first tested whether average closeness differed between groups, mostly to see if STEM students, LGBQ students, or TGNC students reported a different average level of closeness than their peers. The results of these tests are presented in Table 2. In terms of between-group differences, STEM students in our sample only differed from non-STEM students in terms of the average closeness among their personal support network members, with non-STEM students reporting a slightly higher average than STEM students. No difference was observed for average closeness among students' academic support network members. With respect to sexual orientation, LGBQ students did not report a difference in average closeness with their personal support network members relative to heterosexual students, but a difference was observed for their academic support network members. LGBQ students reported a lower average closeness among their academic support network members than heterosexual students did. TGNC students reported lower average closeness among both personal and academic support network members than their cisgender peers did.

Regarding the relationship between closeness and STEM identity, shown in Table 3, average closeness among academic support network members was not a significant predictor of any of the four dependent variables, but average closeness among personal support network members was a significant predictor of all four. Students who were closer, on average, to their sources of personal support also reported higher interest in their field, higher perceptions of competence and performance in their field, and higher recognition as a science person, but also lower recognition as an engineering person. To some extent, then, it seems that access to personal support can bolster field-based identity, especially science identity, but perhaps these kinds of relationships are stronger for students outside of engineering. Findings regarding the relationship between our three control variables and the four indicators of identity reproduce the relationships presented in our earlier research (see Hughes & Teye, 2024).

EDUCATIONAL IMPORTANCE

The purpose of our study was to explore the relationship between social support and science or engineering identity, particularly for LGBTQ college students. Our findings make a unique contribution to the literature, as few, if any, studies have explored science and engineering identity among LGBTQ populations, or the relationship between these identities and network

Table 2. *T-tests comparing differences in average network closeness by control variables.*

Parameter	STEM		Non-STEM		df	t	p	
	M	SD	M	SD				
Personal Network Closeness	3.671	0.41	3.755	0.35	549	2.427	0.016	*
Academic Network Closeness	2.614	0.84	2.630	0.84	526	0.210	0.834	
	LGBQ		Heterosexual					
Personal Network Closeness	3.677	0.40	3.738	0.36	538	1.806	0.072	
Academic Network Closeness	2.515	0.83	2.746	0.83	516	3.131	0.002	**
	TGNC		Cisgender					
Personal Network Closeness	3.596	0.42	3.722	0.38	546	2.812	0.005	**
Academic Network Closeness	2.430	0.83	2.658	0.84	523	2.286	0.023	*

**Note:* * p<.05, ** p<.01, *** p<.001

Table 3. M*ultivariate regression predicting science and engineering identity.*

	Interest		Rec as Sci Pers		Rec as Eng Pers		Comp/Perf	
	B	SE	B	SE	B	SE	B	SE
Constant	7.365***	0.91	4.147***	1.18	8.246	1.60***	12.315	1.12***
Closeness								
Pers. Ntwk	0.966***	0.24	0.728*	0.31	-0.880	0.42*	1.168	0.29***
Acad. Ntwk	0.097	0.11	0.205	0.14	0.110	0.19	-0.166	0.13
STEM	0.246	0.19	3.752***	0.24	2.519	0.33***	-0.551	0.23***
LGBQ	0.362	0.19	0.156	0.25	-0.811	0.34*	0.227	0.24
TGNC	0.325	0.26	0.122	0.34	-0.207	0.46	0.037	0.32

**Note:* * p<.05, ** p<.01, *** p<.001

characteristics. First, we found that network closeness did vary between LGBTQ students and their peers, which is important given that various types of support—such as emotional, instrumental, and informational support—are linked to the different dimensions of science and engineering identity, shaping how individuals view their place within a field (French et al., 2006; Sax et al., 2015). In our study, closeness in personal support networks positively predicted three of the four dimensions of identity, including recognition as a science person, but had a small, negative relationship with recognition as an engineering person. This finding may suggest that closeness is less relevant to engineering identity than science identity, that engineering identity may need less personal and more instrumental or career-focused support. However, further exploration into the distribution of specific majors within the sample is warranted to see if this finding is driven by the representation of engineering majors within the overall sample.

Educators often concern themselves with understanding the kinds of support to which students have access as a concern for their mental and physical well-being (Brooker et al., 2017; Meyer, 2003), and our results extend this concern to academic and professional outcomes as well. One potential implication is that personal support may also motivate them to persist in their studies

and commit to achieving their goals (Deci & Ryan, 2000). This implication is not necessarily ground-breaking, but a good reminder that students should be encouraged to maintain connections to their strongest sources of support as a way of bolstering their science or engineering identities. Instructors might find it helpful to remind students to check in regularly with mentors, family members, advisors, friends, or any number of people who can champion their efforts to succeed in their studies. This implication could also extend to those people students rely on for academic support as there is no reason these people could not also provide personal support as well. Although we plan to explore the finding regarding recognition as an engineering person further, we do acknowledge that it could reflect the need to help engineering students manage their personal support relationships in a manner that aids those individuals to better understand what it takes to succeed in engineering and become a practicing engineer.

That said, we did find that cisgender and heterosexual students seemed to have access to a greater degree of personal and academic support than their LGBTQ peers. This difference in network closeness may reflect a systemic barrier that LGBTQ students face in pursuit of a STEM degree, in that they may not be as close to their network members due to having access to fewer members who share LGBTQ social group membership with them (Hughes & MGWatson, 2023). Short of increasing the retention and representation of LGBTQ students in STEM majors, this finding continues to demonstrate the need for affinity-based organizations like oSTEM or Queer-Straight Alliances as places for students to find other sources of personal support. Other opportunities that have been shown to foster field-based identity development among underserved students through access to supportive relationships, role models, and authentic settings are informal STEM learning experiences which promote interaction among students (Çolakoğlu et al., 2023).

Broadening the participation of people from groups historically excluded from STEM, like LGBTQ people, is important for the future vitality of the STEM workforce. In this study, we studied how social support may bolster science and engineering identity, an indicator of intrinsic motivation to select and persist in a STEM field through one's career trajectory. We found that LGBTQ students have differential access to social support, measured as closeness with members of their personal and academic support networks, and that personal support in particular could be important for building science identity. Fostering better interpersonal interactions and intergroup relations, as well as building LGBTQ communities within STEM, could all increase the support available to LGBTQ students in their pursuit of a STEM field, which then could help sustain their deeper motivations to follow through on their STEM aspirations to make important contributions to further society.

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